

# Fax

**To:**

Board of Patent Appeals  
and Interferences  
Case 2009-1853

Alexandria, VA  
22313-1450

From: Dr. Mitchell Swartz  
Weston, MA 02493

**RESPONSE UNDER 37  
CFR 1.116**

**EXPEDITED  
PROCEDURE**

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**Fax:**

FAX 571 273 0052

**Date:**

October 17, 2011

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**Phone:**

**Pages:** (including this page)

**Re:** Petition to Commissioner re: CC:

pro se APPEAL BRIEF

Thank you.

Case Number Redacted by

Examiner Palabrica

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Serial No : 09/ 750,765 Filed: 12/28/00

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**RESPONSE UNDER 37 CFR 1.116  
EXPEDITED PROCEDURE**

**UNITED STATES PATENT AND TRADEMARK OFFICE  
Board of Patent Appeals and Interferences  
Checks Cashed, *pro se* Appeal Briefs Withheld  
Case Numbers Redacted by Dr. Ricardo Palabrica *et alia***

**IN RE THE APPLICATION OF:**

Inventor : Mitchell R. Swartz  
Serial no. 09/ 750,765  
Filed: 12/28/00  
For: **METHOD AND APPARATUS  
TO CONTROL ISOTOPIC FUEL  
LOADED WITHIN A MATERIAL**  
This is a continuation of Serial no. 07/ 760,970  
Filed: 09/17/1991

**PAPER:**

Group Art Unit: 3641  
Examiner: Mr. Palabrica, R.J.

October 17, 2011

**Commissioner of Patents and Trademarks**  
Box 1450 Alexandria, VA 22313-1450

**PETITION TO THE COMMISSIONER  
PURSUANT TO 37 C.F.R. 1.181**

1. This Petition is made by the *pro se* Appellant pursuant to 37 C.F.R. 1.181 to the Commissioner of Patents, and is made to invoke his supervisory authority to correct a wrongful situation involving a Decision of 04/04/2007, signed by Donald Hajec, ruling on his own group [Exhibit "A"; hereinafter simply 'Decison'].

2. Pursuant to 37 C.F.R. 1.181, there is no fee. This Petition is reasonable based upon the reasons stated below, and the facts as discussed in the Declarations supporting this Petition.

3. In the discussion below, reference is made to the Declaration of Dr. Mitchell Swartz (hereinafter called the "Swartz Declaration") dated October 17, 2011. In addition, attention is directed to the previous Swartz Declarations dated May 5, 2003, April 21, 2004, May 26, 2004, April 10, 2006, May 25 2006. Attention is also directed to the previous Verner Declarations dated April 21, 2004, and several Declarations submitted on October 23, 2002.

## BACKGROUND

4. Serial no. 09/750,765 is a continuation of Serial no. 07/ 760,970. It involves a two-stage process involving loading of hydrogen into a metal electrode such as palladium. Applicant taught using a first stage of electrode loading, followed by, a second stage of sudden rapid ("catastrophic") flow of the loaded hydrogen within the metal. Applicant taught in the original specification and claims how this apparatus works and presented objective detailed evidence of the invention. The first stage is the electrode loading, and then, in the second stage a rapid ("catastrophic") flow of hydrogen results within the metal. After the initial loading, said flow (or flux) of hydrogen takes place until the previously-loaded palladium is spent of its deuterons or the material is otherwise damaged.

5. The Applicant appealed the Examiner. The *pro se* Appellant filed Appeal Briefs. The first *pro se* Appeal Brief was filed on October 24, 2003 ( tk pages). Under the unending demands of Dr. Ricardo Palabrica, the second, revised *pro se* Appeal Brief was then refiled on January 4, 2004 (tk pages, again in triplicate with triplicate Exhibits) All have since been sequestered, removed, "lost" or destroyed by Dr. Ricardo Palabrica et alia.

**6. There were no deficiencies as the Office purports. The Appellant made every attempt to comply with 37 CFR 1.192(c) in an organized manner for judicial economy and to maximize clarity for the Board.**

7. MPEP 1206 states:

**"An exception to the requirement that all the itemsspecified in 37 CFR 1.192(c) be included in the brief is made if the application or reexamination proceeding is being prosecuted by the appellant *pro se*".**

8. The Appellant addressed the Compliance and other relevant issues both in the Swartz Declarations and in the other, too long-ignored responses and communications to the USPTO. For example, the Appellant addressed these issues in his (sequestered, "lost" or destroyed) missives entitled, Notice of Compliance [January 4, 2004], Motion for Sanctions [April 21, 2004], and Responses to the USPTO [April 21, 2004 and May 26, 2004].

9. The *pro se* Appellant has also filed an unaddressed Motion for Sanctions supported by un rebutted Declarations. The Examiner Dr. Ricardo Palabrica has systematically ignored timely submitted responses. In addition, he has systematically ignored timely submitted Declarations and other Exhibits (some of which on information and belief have been "missing" from the file folder).

10. The response of the Office to the *pro se* compliant Appeal Briefs involving energy production has been the following:

The Office has ignored the *pro se* Appellant's Appeal Briefs.

The Office has ignored the *pro se* Appellant's Responses.

11. The *pro se* Appellant has also filed several substantively ignored Petitions to the Commissioner supported by un rebutted Declarations. The issues involve matters of impropriety which have not even been addressed. Specifically, the Office has ignored the issues in Appellant's Petitions filed on April 26, 2004 and May 28, 2004.

12. The response of the Office to the Petitions has been the following:

The Office has ignored documented complaints by the *pro se* Appellant.

The Office has ignored the *pro se* Appellant's Petitions to the Commissioner.

13. The Decision of 04/04/2007, signed by Donald Hajec, ruling on his own group, states that the Petition is "DISMISSED as MOOT" [hereinafter "Dismissed"]. As the Swartz Declaration states,

**"The Petition is "DISMISSED as MOOT" but the Decision has not even substantively addressed the serious issues of said Petition. The Decision is egregious because the issues in the Petition which have been ignored involve the Office failing to respond to arguments, failing to respond to Declarants, and other matters of impropriety. Furthermore, the Decision is itself an impropriety since it is signed by Donald Hajec ruling on his own group's questionable conduct."**

14. The Decision has the appearance of impropriety. The Decision is not accurate and is unfair.

15. The Decision has the appearance of impropriety. The Decision does not address the issues of said Petitions.

16. The Decision has the appearance of impropriety. The Petitioner requested to know the substantive precise reason, scientific basis, or authority which allowed the Office to dismiss the Arguments by the Applicant without citation, analysis, or substantive coherent response. That issue, like the other issues, were simply ignored.

17. The Decision has the appearance of impropriety. Mr. Hajec, ruling on his own group, did not cite Petitioner's arguments, discuss Petitioner's arguments, or rebut Petitioner's arguments. Therefore it is impossible to tell how the Office weighed Petitioner's arguments. There was absolutely no way for the Petitioner to present the Office's reasons for rejection to the Board of Appeals or the federal or state courts in the Commonwealth of Massachusetts.

### **APPEAL BRIEF SEQUESTRATION IS SERIOUS AND IMPORTANT**

18. Attention is directed to Exhibits "B" and "C" of which Examiner Palabrica was notified by Declaration. These are serious matters. Dr. Palabrica has said there was "no utility" when the DIA and DTRA and NRL had said otherwise of the Applicant of the above-entitled Application, and the subject matter of the above entitled Application. As the Swartz Declaration states,

**"I previously informed Examiner Palabrica of the relevant matters such as described in Exhibits "B" and "C". In return, he has been disingenuous on federal documents and with the Board of Patent Appeal, purporting that there is "no utility" to the above-entitled invention even when documents associated with the DIA, DTRA, NRL, and other agencies have indicated the opposite."**

19. The Decision has the appearance of impropriety. The sequestered *pro se* Appeal Brief is relevant to the Board of Patent Appeals. It is not only a travesty that it has been withheld, but it is also relevant to other cases presently before the Board which directly affect and are directly affected by or have a bearing on the Board's decision in the pending appeal.

20. The Decision has the appearance of impropriety. The reason the Appeal Briefs have been withheld by the Examiner(s) who are exposed having also removed Evidence from those file folders in cases which were before the Board of Patent Appeals (*vide infra*).

21. The Decision has the appearance of violations of MGL 93A. The Office has for years continued to cash the Applicant's checks for patent applications and then Appellant's (then Applicant's) checks for Appeals before the Board of Patent Appeals which has been denied to the *pro se* Applicant by disingenuous statements.

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22. The Decision has the appearance of obstruction of justice and systematic abuse. The Examiner Dr. Ricardo Palabrica has systematically attempted to throw out each of Applicant's (now Appellant's) applications, including the above-entitled application, using false statements, false abandonments.

23. Since the Appeal Brief was filed, there has been a systematic delay to send this to the Board for years. This has the appearance of impropriety and may be perceived as an obstruction of justice and egregious lack of ethics.

### LAW

24. The *pro se* Appellant has been compliant, timely, and complete. The present Decision, as it stands, has both the salient appearance of impropriety and obstruction of justice.

25. The Office has ignored several laws and its own rules, including but not limited to:

26. There have been violations by the Office of MPEP 1206.

27. There have been violations by the Office of 18 U.S.C. §1001.

28. There have been violations by the Office of the 5th Amendment and 14th Amendment; also "equal protection" clauses, and 42 U.S.C. §1983.

29. There have been violations by the Office of Title 18 U.S.C., Sections 1831 and 1832.

30. The Office has ignored U.S. Rep volume 404, pages 520-521 (72).

COUNT #1 - Violation of 18 U.S.C. §1001

COUNT #2 - Regulatory Abuse

COUNT #3 - Obstruction of Justice

COUNT #4 - Misprision of Felony by Robert W. Bahr

COUNT #5 - Misprision of Felony by Donald T. Hajec

COUNT #6 - Misprision of Felony by Past Director Jon W. Dudas

COUNT #7 - Misprision of Felony by Director of Patents

31. Therefore, as discussed above, the Decision was in error and should be corrected. This Petition is an attempt by the Petitioner for judicial economy. .

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32. Appellant notes that the U.S. Supreme Court has ruled that any *pro se* litigant is entitled to less stringent standards [U.S. Rep volume 404, pages 520-521 (72)].

WHEREFORE, this Petition, supported by Affidavit and consistent with proven facts in the record, proves the Appellant correct. Applicant (now Appellant) respectfully requests

i) relief from the Examiner's false statements made on federal documents sent through the US mail to obstruct justice, precisely that the above-entitled application file was NOT abandoned, and

ii) a recusal of the Examiner Ricardo Palabrica from all of Applicant's cases, and

iii) properly transferring the Dr.Palabrica-sequestered Appeal Brief to the Board of Patent Appeals immediately consistent with the checks which were cashed and compliant *pro se* Appeal Briefs were delivered.

Respectfully submitted,

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Mitchell Swartz, ScD, MD, EE

**CERTIFICATE OF MAILING [37 CFR 1.8(a)]**

October 17, 2011

To Whom it Does Concern:

I hereby certify that this correspondence will be deposited with the United States Postal Service by First Class Mail, postage prepaid, in an envelope addressed to "The Commissioner of Patents and Trademarks Washington, D.C. 20231" on the date below.

Thank you.

Sincerely,

October 17, 2011

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M.R. Swartz

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**UNITED STATES PATENT AND TRADEMARK OFFICE**  
**Board of Patent Appeals and Interferences**  
**Checks Cashed, *pro se* Appeal Briefs Withheld**  
**Case Numbers Redacted by Dr. Ricardo Palabrica *et alia***

IN RE THE APPLICATION OF:

PAPER:

Inventor : Mitchell R. Swartz

Group Art Unit: 3641

Serial no. 09/ 750,765

Examiner: Mr. Palabrica, R.J.

Filed: 12/28/00

For: **METHOD AND APPARATUS  
TO CONTROL ISOTOPIC FUEL  
LOADED WITHIN A MATERIAL**

This is a continuation of Serial no. 07/ 760,970

Filed: 09/17/1991

October 17, 2011

**Commissioner of Patents and Trademarks**

Box 1450 Alexandria, VA 22313-1450

**DECLARATION OF DR. M. SWARTZ**  
**SUPPORTING PETITION to the COMMISSIONER**

I, Mitchell R. Swartz, declare that I am a citizen of the United States of America and the inventor of the invention described in the above-entitled application.

1. I have a background in electrical engineering, material science, electrochemistry, nuclear physics, and medicine. I have worked in these fields for almost thirty years, and have worked on medical and scientific experimental projects at the Massachusetts Institute of Technology, Massachusetts General Hospital, Harvard Medical School, and elsewhere.

2. I have received an unfair and wrongful Decision [Exhibit "A"] dated 4/04/2007.

3. The Petition is "DISMISSED as MOOT" but the Decision has not even substantively addressed the serious issues of said Petition.



4. The Decision is egregious because the issues in the Petition which have been ignored involve the Office failing to respond to arguments, failing to respond to Declarants, and other matters of impropriety.

5. Furthermore, the Decision is itself an impropriety since it is signed by Donald Hajec ruling on his own group's questionable conduct.

6. I previously informed Examiner Palabrica of the relevant matters such as described in Exhibits "B" and "C". In return, he has been disingenuous on federal documents and with the Board of Patent Appeal, purporting that there is "no utility" to the above-entitled invention even when documents associated with the DIA, DTRA, NRL, and other agencies have indicated the opposite.

I declare that all statements herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signature of Inventor:

October 17, 2011

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Mitchell R. Swartz, ScD, MD, *pro se*  
Weston, Mass. 02481



# UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents  
United States Patent and Trademark Office  
P.O. Box 1450  
Alexandria, VA 22313-1450  
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FROM DIRECTORS OFFICE

APR 04 2007

TECHNOLOGY CENTER 3600

Mitchell R. Swartz ScD, MD, EE  
16 Pembroke Road  
Weston, MA 02493

In re Application of  
Mitchell R. Swartz  
Application No. 09/750,765  
Filed: December 28, 2000  
For: METHOD AND APPARATUS TO CONTROL  
ISOTOPIC FUEL LOADED WITHIN A  
MATERIAL

DECISION ON THE PETITION  
UNDER 37 CFR 1.181

Exhibit "A"

This is a decision on applicant's petitions filed on May 30, 2006 under 37 CFR 1.181, to the petition decision dated May 22, 2006 regarding the non-compliant Appeal Brief.

The petition is **DISMISSED as MOOT**.

## DISCUSSION

It is noted that the application is currently in abandoned status. Applicant petitioned the holding of abandonment in the petition dated June 15, 2006 which is currently with the Office of Petitions. It appears that the issues addressed in this petition are included in the above noted petition and will be addressed along with the issue of abandonment. No decision has been rendered by the Office of Petitions as of the date of this decision.

Accordingly, the May 30, 2006 petition is moot as the application is in abandoned status. Petitions do not extend time periods and are not considered to be proper responses.

## ADDITIONAL DISCUSSION

It is noted that applicant has filed numerous petitions regarding this application and other co-pending applications the petitioner is advised that the Office has, pursuant to 35 U.S.C. § 1, established a federal regulation (37 CFR 10.18) that governs, among other things, the conduct of parties appearing before the Office whether in person, or in writing. Federal regulations have the force of law. For petitioner's benefit, the statute and regulation read as follows, in pertinent part:

### 35 U.S.C. 1 Establishment.

(a) **ESTABLISHMENT.**— The United States Patent and Trademark Office is established as an agency of the United States, within the Department of Commerce.

...

(b) **SPECIFIC POWERS.**— The Office—

...

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Defense Intelligence Agency

EXHIBIT "C"

***Defense Analysis Report***

DIA-08-0911-003

13 November 2009

**Technology Forecast: Worldwide Research on Low-Energy Nuclear Reactions Increasing and Gaining Acceptance**

*Scientists worldwide have been quietly investigating low-energy nuclear reactions (LENR) for the past 20 years. Researchers in this controversial field are now claiming paradigm-shifting results, including generation of large amounts of excess heat, nuclear activity and transmutation of elements.<sup>1, 2, 3</sup> Although no current theory exists to explain all the reported phenomena, some scientists now believe quantum-level nuclear reactions may be occurring. DIA assesses with high confidence that if LENR can produce nuclear-origin energy at room temperatures, this disruptive technology could revolutionize energy production and storage, since nuclear reactions release millions of times more energy per unit mass than do any known chemical fuel.<sup>4, 5</sup>*

**Background**

In 1989, Martin Fleischmann and Stanley Pons announced that their electrochemical experiments had produced excess energy under standard temperature and pressure conditions.<sup>6</sup> Because they could not explain this physical phenomenon based on known chemical reactions, they suggested the excess heat could be nuclear in origin. However, their experiments did not show the radiation or radioactivity expected from a nuclear reaction. Many researchers attempted to replicate the results and failed. As a result, the physics community disparaged their work as lacking credibility, and the press mistakenly dubbed it "cold fusion." Related research also suffered from the negative publicity of cold fusion for the past 20 years, but many scientists believed something important was occurring and continued their research with little or no visibility. For years, scientists were intrigued by the possibility of producing large amounts of clean energy through LENR, and now this research has begun to be accepted in the scientific community as reproducible and legitimate.

**Source Summary Statement**

This assessment is based on analysis of a wide body of intelligence reporting, most of which is open source information including scientific briefings, peer-reviewed technical journals, international scientific conference proceedings, interviews with scientific experts and technical media. While there is little classified data on this topic due to the S&T nature of the information and the lack of collection, DIA judges that these open sources generally provide the most reliable intelligence available on this topic. The information in this report has been corroborated and reviewed by U.S. technology experts who are familiar with the data and the international scientists involved in this work.

Although much skepticism remains, LENR programs are receiving increased support worldwide, including state sponsorship and funding from major corporations.<sup>7, 8, 9, 10</sup> DIA assesses that Japan and Italy are leaders in the field, although Russia, China, Israel, and India<sup>11</sup> are devoting significant resources to this work in the hope of finding a new clean

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energy source. Scientists worldwide have been reporting anomalous excess heat production, as well as evidence of nuclear particles<sup>12, 13, 14</sup> and transmutation.<sup>15, 16, 17</sup>

- Y. Iwamura<sup>18</sup> at Japan's Mitsubishi Heavy Industries first detected transmutation of elements when permeating deuterium through palladium metal in 2002.
- Researchers led by Y. Arata at Osaka University in Japan<sup>19</sup> and a team led by V. Violante at ENEA in Italy (the Italian National Agency for New Technologies, Energy, and the Environment—the equivalent to the U.S. Department of Energy)<sup>20</sup> also made transmutation claims.
- Additional indications of transmutation have been reported in China, Russia, France, Ukraine, and the United States.<sup>21, 22</sup>
- Researchers in Japan, Italy, Israel, and the United States have all reported detecting evidence of nuclear particle emissions.<sup>23, 24</sup>
- Chinese researchers described LENR experiments in 1991 that generated so much heat that they caused an explosion that was not believed to be chemical in origin.<sup>25</sup>
- Japanese, French, and U.S. scientists also have reported rapid, high-energy LENR releases leading to laboratory explosions, according to scientific journal articles from 1992 to 2009.<sup>26, 27</sup>
- Israeli scientists reported in 2008 that they have applied pulsating electrical currents to their LENR experiments to increase the excess energy production.<sup>28</sup>
- As of January 2008, India was reportedly considering restarting its LENR program after 14 years of dormancy.<sup>29</sup>

U.S. LENR researchers also have reported results that support the phenomena of anomalous heat, nuclear particle production, and transmutation.<sup>30, 31, 32</sup>

- At the March 2009 American Chemical Society annual meeting, researchers at U.S. Navy SPAWAR Pacific reported excess energy,<sup>33</sup> nuclear particles,<sup>34</sup> and transmutation,<sup>35, 36</sup> stating that these effects were probably the result of nuclear reactions.<sup>37</sup>
- A research team at the U.S. company SRI International has been studying the electrochemistry and kinetics of LENR since the early 1990's, reporting excess heat and helium production.<sup>38</sup>

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- In May 2002, researchers at JET Thermal in Massachusetts reported excess heat and optimal operating points for LENR manifolds.<sup>39</sup>
- Researchers at the China Lake Naval Air Warfare Center in California first reported anomalous power correlated with Helium-4 production in 1996.<sup>40</sup>

Although no one theory currently exists to explain all the observed LENR phenomena, some scientists now believe these nuclear reactions may be small-scale deuterium fusion occurring in a palladium metal lattice.<sup>41, 42, 43</sup> Some others still believe the heat evolution can be explained by non-nuclear means. Another possibility is that LENR may involve an intricate combination of fusion and fission triggered by unique chemical and physical configurations on a nanoscale level.<sup>44, 45</sup> **This body of research has produced evidence that nuclear reactions may be occurring under conditions not previously believed possible.** Recent results suggest these anomalous LENR phenomena can be triggered by various energetic stimuli (electric and magnetic fields, acoustic waves, infrared, lasers)<sup>46, 47</sup> and may have a variety of operational modes.

### Nuclear Fusion

Nuclear fusion as currently understood occurs only in the core of stars, in nuclear weapons, in high temperature plasmas, or in inertially confined high-energy collisions. Scientists for years have attempted to harness nuclear fusion through high-temperature plasma techniques but have been unable to produce more energy output than supplied. Fusion was once thought to be the answer to the world's future clean energy needs, but after 60 years of research still has yet to live up to this promise. "Hot" fusion researchers do not believe fusion can occur at near-room temperatures based on the Coulomb barrier that repels like nuclear charges and have dismissed much of the "cold fusion" research conducted since 1989. As a result, such research has received limited funding and support over the past 20 years.

### Potential Applications of LENR: The Technology Surprise Factor

LENR's potential as a future clean energy source is still unknown. However, recent results indicating nuclear activity and transmutation are intriguing and pose the following questions:

- If the excess heat from these experiments could be captured and intensified, could LENR be used as a power source for engines, batteries, or other equipment?
- If nuclear particles could be generated and transmute elements, could LENR be used to mitigate hazardous waste or to neutralize weapons of mass destruction?<sup>48</sup>
- If the various modes of energy production could be identified and optimized, could LENR be used to create designer materials or critical resources that are in short supply or serve as a tailored, "dial-a-mode" power source?

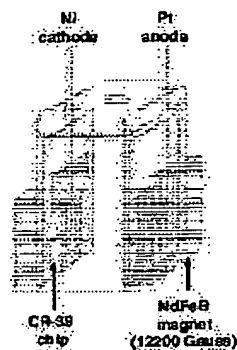
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- If rapid, explosive energy output can occur in one or several modes, could LENR serve as a new high-energy-density explosive?

International LENR research was highlighted in April 2009 on a U.S. television program focused on the 20th anniversary of the Fleischman and Pons announcement.<sup>49</sup> Many U.S. researchers are collaborating with foreign scientists, but each team has proprietary aspects of their experiments that are not shared. Because some peer-reviewed journals are reluctant to review or publish LENR data due to past controversies, most results are presented at international conferences, and foreign scientists have access to much of the U.S. data. In addition, U.S. experts have been invited to brief on LENR to nuclear institutes in India,<sup>50</sup> Belgium,<sup>51</sup> and South Korea,<sup>52</sup> and a reciprocal visit by South Koreans to SPAWAR Pacific to initiate collaboration is planned. This relatively free flow of information increases the likelihood of a technology breakthrough—as well as the potential for technology surprise—by an international team, especially those from countries that are devoting more resources to this research than is the United States, and are supported with major corporate funding (Mitsubishi, Toyota, and Honda in Japan; Pirelli in Italy).<sup>53</sup>

### The Experiments

Most LENR experiments involve electrodes immersed in solutions of metal salts such as lithium chloride or lithium sulfate, with heavy water substituted for natural water. Electric current is sent through the experimental apparatus, in most instances producing excess heat. This effect occurs over long periods (several hundreds of hours), and many early experimenters achieved negative results because they were unaware of this incubation period. Israeli researchers used pulsating electric fields to increase heat production. The application of magnetic fields has been shown to stimulate increased heat and power. Usually one of the electrodes is palladium, because it has a high ability to adsorb (hold on the surface) and absorb deuterium atoms in its metal matrix. Deuterium is an isotope of hydrogen that undergoes fusion in nuclear weapons at high temperatures and pressures; it also undergoes fusion and is one of the basic building blocks of the heavier elements formed in stars. The Navy SPAWAR experiments used a unique technique to place the palladium atoms in the heavy-water solution and to codeposit palladium and deuterium, which rapidly increases the deuterium "loading" necessary for the LENR phenomena to occur.



A Notional LENR Electrochemical Cell (Left) and a French LENR Apparatus After an Unexplained Explosion (Right)<sup>54</sup>

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### Who's Hot in Cold Fusion?

The countries with the most advanced LENR programs are Japan, Italy, and Israel. In addition, Russia, France, China, South Korea, and India are spending significant resources on LENR research. The following are among the most notable efforts:

- In Japan, Iwamura at Mitsubishi has been studying transmutation of elements in LENR experiments and multilayer palladium (Pd) complexes. His team includes the Japanese Synchrotron Radiation Research Institute and Spring-8 at Riken. Kitamura and other researchers at Kobe University are investigating Pd nanopowders and Helium-4 ash. Arata at Mitsubishi Heavy Industries has worked on catalysts containing nanopalladium. Yamaguchi at Kobe noted transmutation using multilayered Pd samples. Mizuno at Hokkaido is studying transmutations and heat generation. A team led by Hioki at Toyota is investigating deuterium gas permeation through Pd as well as transmutations. Toriyabe at Tohoku University is developing charged-particle detectors for LENR. Kasagi is looking at electron and ionic screening in LENR effects.
- Vittorio Violante, a leader in the field of Pd metallurgy and the role of surface effects in LENR, heads a team at ENEA, Frascati, Rome, (the Italian equivalent to the U.S. Department of Energy) performing LENR experiments. A team led by Francesco Celani at INFN that includes STMicroelectronics and Pirelli labs is studying deuterium migration in nanocoated Pd for fast-loading and anomalous heat effects. The Italian Physical and Chemical Societies are supporting LENR research in Italy.
- Srinivasan in India noted that India is restarting its LENR program; the Bhabha Atomic Research Centre had several groups working on LENR from 1989 to the early 1990s. Sinha at IISc in Bangalore is studying models for fusion in metal deuterides. Lakshmanan at Saveetha College is exploring fusion in sodium metal solutions.
- Andrei Lipson and other researchers at the Russian Academy of Sciences and scientists in Tomsk are studying the emission of charged particles during the use of electron beams to excite palladium/deuterium (Pd/D) and titanium/deuterium (Ti/D) targets. Karabut and others at LUCH also are conducting LENR experiments. A Dubna team led by Gareev is studying nuclear fusion during cavitation and molecular transitions. LUCH's Savvatimova, Dash, Muromisev, and Artamonov also are conducting LENR experiments. Adamenko and Vysotskii of Kiev are looking for magnetic monopoles in LENR experiments. Kurchatov-based scientist Goryachev is investigating LENR for alternative energy sources and for mitigating radioactive waste.
- Xing Z. Li at Tsinghua University claims 20 institutions in China are investigating LENR with governmental support. Tian's team at Gannan University of Science and Technology is investigating laser triggering in Pd/D systems. Zhang and other researchers at the Chinese Academy of Sciences have studied Pd-D kinetics in LENR since 1991.
- Israeli scientists at Energetics in Omer have shown that variations in energy output can be increased using variable frequency or pulsed "superwaves" to stimulate LENR effects.
- The French Atomic Energy Agency had an official LENR program from 1997 to 1999. EDF also had one for several years. Currently, Jean-Paul Biberian from the Université Marseille and Jacques Dufour at CNAM are working on LENR in France.
- Jan Marwan of Dr. Marwan Chemie in Berlin, Germany, is studying the nanostructure of palladium hydride systems. Huke and others from the Technische Universität Berlin are working with Czerski in Poland and Ruprecht in Canada on electron screening mechanisms for deuteron fusion.



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### Outlook and Implications

If nuclear reactions in LENR experiments are real and controllable, DIA assesses that whoever produces the first commercialized LENR power source could revolutionize energy production and storage for the future. The potential applications of this phenomenon, if commercialized, are unlimited. The anomalous LENR effects seen in these metal lattices containing deuterium may also have as-yet undetermined nanotechnology implications. LENR could serve as a power source for batteries that could last for decades, providing power for electricity, sensors, military operations, and other applications in remote areas, including space. LENR could also have medical applications for disease treatment, pacemakers, or other equipment. Because nuclear fusion releases **10 million times more energy per unit mass** than does liquid transportation fuel, the military potential of such high-energy-density power sources is enormous. And since the U.S. military is the largest user of liquid fuel for transportation, LENR power sources could produce the greatest transformation of the battlefield for U.S. forces since the transition from horsepower to gasoline power.

Prepared by: Beverly Barnhart, DIA/DI, Defense Warning Office. With contributions from: Dr. Patrick McDaniel, University of New Mexico; Dr. Pam Mosier-Boss, U.S. Navy SPAWAR/Pacific; Dr. Michael McKubre, SRI International; Mr. Lawrence Forsley, JWK International; and Dr. Louis DeChiaro, NSWC/Dahlgren.

Coordinated with DIA/DRI, CPT, DWO, DOE/IN, US Navy SPAWAR/Pacific and U.S. NSWC/Dahlgren, VA.

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<sup>1</sup> Bockris, John, "The History of the Discovery of Transmutation at Texas A&M University," paper presented at the 10<sup>th</sup> International Conference on Cold Fusion (ICCF), Cambridge, MA, 2003.

<sup>2</sup> 14<sup>th</sup> International Conference on Cold Fusion (ICCF), Washington, DC, 10-15 August 2008.

<sup>3</sup> The number of protons in the nucleus of an atom determines the identity of the chemical element. Nuclear transmutation occurs when the number of protons in the nucleus is changed by adding or removing protons or converting them to other nuclear particles. Thus transmutation changes one chemical element into another through a nuclear process.

<sup>4</sup> Benedict, M., T. Pigford, and H. Levi, "Nuclear Chemical Engineering," McGraw Hill Series in Nuclear Engineering, 1981.

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<sup>7</sup> DeChiaro, Louis, "Recent Progress in Low Energy Nuclear Reactions," briefing prepared by NAVSEA, Dahlgren, for DDR&E, 28 August, 2009.

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<sup>9</sup> Hioki, Tatsumi, et al., "Influence of Deuterium Gas Permeation on Surface Elemental Change of Ion-Implanted Pd," 14<sup>th</sup> International Conference on Cold Fusion (ICCF), Washington, DC, 10-15 August 2008.

<sup>10</sup> Celani, Francesco, et al., "Deuteron Electromigration in Thin Pd Wires Coated with Nano-Particles: Evidence for Ultra-Fast Deuterium Loading and Anomalous, Large Thermal Effects," 14<sup>th</sup> International Conference on Cold Fusion (ICCF), Washington, DC, 10-15 August 2008.



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- <sup>11</sup> "Exciting New Science: Potential Clean Energy," Abstracts, 14<sup>th</sup> International Conference on Condensed Matter Nuclear Science and International Conference on Cold Fusion (ICCF), Washington, DC, 10-15 August 2008.
- <sup>12</sup> Mosier-Boss, et al., "Triple Tracks in CR-39 as the Result of Pd/D Co-deposition: Evidence of Energetic Neutrons," *Naturwissenschaften*, 96, 2009, 135-142.
- <sup>13</sup> Mosier-Boss, et al., Navy SPAWAR briefing, American Chemical Society annual meeting, March 2009.
- <sup>14</sup> "Exciting New Science: Potential Clean Energy," Abstracts, 14<sup>th</sup> International Conference on Condensed Matter Nuclear Science and International Conference on Cold Fusion (ICCF), Washington, DC, 10-15 August 2008.
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- <sup>18</sup> Iwamura, Yashiro, et al., "Elemental Analysis of Pd Complexes: Effects of D<sub>2</sub> Gas Permeation," *Japan Journal of Applied Physics*, Vol. 41, 2002, pp. 4642-4650.
- <sup>19</sup> Arata, Y., "Anomalous Effects in Charging of Pd Powders with High-Density Hydrogen Isotopes," *Physics Letters A*, 373, 2009, pp. 3109-3112.
- <sup>20</sup> Violante, V. et al., "On the Correlation of PdD Alloy Material Properties with the Occurrence of Excess Power," briefing presented at 14<sup>th</sup> International Conference on Cold Fusion (ICCF), Washington, DC, 10-15 August 2008.
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- <sup>22</sup> Briefings presented at Navy SPAWAR San Diego, LENR meeting, 4-5 August, 2009.
- <sup>23</sup> Mosier-Boss, et al., "Triple Tracks in CR-39 as the Result of Pd/D Co-deposition: Evidence of Energetic Neutrons," *Naturwissenschaften*, 96, 2009, 135-142.
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- <sup>30</sup> Mosier-Boss, et al., multiple briefings presented at Navy SPAWAR Pacific, August 4-5, 2009.
- <sup>31</sup> McKubre, Michael, "Studies of the Fleischmann-Pons Effect at SRI International," briefing presented at Vice Chancellor for Research Seminar on LENR, University of Missouri, May 2009.
- <sup>32</sup> Spzak, Stan, et al., "Evidence of Nuclear Reactions in the Pd Lattice," *Naturwissenschaften*, 92, 2005, 394-397.
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Defense Threat Reduction Agency  
8725 John J. Kingman Road, MSC 6201  
Fort Belvoir, VA 22060-6201



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Advanced Systems and Concepts Office  
**FINAL REPORT**

*High Energy Science & Technology  
Assessment*

June 29, 2007

Authors:

Rich Sutton  
George Ullrich, PhD

Prepared by:

Science Applications International  
Corporation (SAIC)

1710 SAIC Drive  
MCLEAN, VA 22102



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DTRA01-03-D-0017/Task Order 18-05-14

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# High Energy Science and Technology Assessment

## FINAL REPORT

June 29, 2007

Prepared for:



**Defense Threat Reduction Agency  
Advanced Systems and Concepts Office**

**Contract No: DTRA01-03-D-0017**

**Task Order 18**

**Technical Instruction 18-06-11**

**Prepared by:**

**Rich Sutton, George Ullrich**

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**SPONSOR:** Defense Threat Reduction Agency  
Dr. James Tegnalia  
Director

Advanced Systems and Concepts Office  
Dr. Michael Wheeler  
Director

**BACKGROUND:** The Defense Threat Reduction Agency (DTRA) was founded in 1998 to integrate and focus the capabilities of the Department of Defense (DoD) that address the weapons of mass destruction threat. To assist the Agency in its primary mission, the Advanced Systems and Concepts Office (ASCO) develops and maintains an evolving analytical vision of necessary and sufficient capabilities to protect United States and Allied forces and citizens from WMD attack. ASCO is also charged by DoD, and by the U.S. Government generally, to identify gaps in these capabilities and initiate programs to fill them. It also provides support to the Threat Reduction Advisory Committee (TRAC), and its Panels, with timely, high quality research.

**ASCO ANALYTICAL SUPPORT:** Science Applications International Corporation has provided analytical support to DTRA since the latter's inception through a series of projects on chemical, biological, and nuclear weapons issues. This work was performed for DTRA under contract DTRA01-03-D-0017, Task Order 18.

**SUPERVISING PROJECT OFFICER:** Mr. David Algert., 703 767-5704

**SCIENCE APPLICATIONS INTERNATIONAL CORPORATION:** 1710 SAIC Drive, McLean, Virginia, 22102. Telephone: (703) 676-5550. Project Coordinator: Dr. George Ullrich, Senior Vice President for Advanced Technology Programs, (703) 676-8752.

**REPORT:** The publication of this document does not indicate endorsement by the Department of Defense, nor should the contents be construed as reflecting the official position of the sponsoring agency.

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## 1.0 Executive Summary

The potential energy that can be tapped from the nucleus ( $> 10^6$  eV/atom) is vastly greater than the energy available from the electronic states of an atom ( $< 1$  eV/atom). The conversion of mass into energy, via fission and fusion reactions, is the basis for the only existing "high-energy" weapons, but further refinements in the design of these weapons, to make them more relevant to the post-Cold War security environment, are certainly possible. Another possible way to extract energy from the nucleus is to exploit the energy stored in metastable isomeric states. Also, despite the negative publicity about "Cold Fusion," the nuclear community continues to watch research in the area of low energy nuclear reactions with guarded optimism for possible future commercial and military applications. Anti-matter annihilation reactions involve the complete conversion of mass to energy with energy densities three orders of magnitude higher than nuclear fission and fusion. The prospect of compactly storing positrons in the form of charge-neutral positronium holds promise for viable military applications of anti-matter.

The Defense Threat Reduction Agency (DTRA) is chartered to monitor new potentially militarily useful sources of energy and to maintain cognizance of others' work in these fields as a hedge against technology surprise.

DTRA tasked SAIC under Contract DTRA01-03-D-0017, Technical Instruction 18-06-11, to conduct a Workshop on a wide range of energy-related technologies that are not chemical in nature, but have credible scientific basis and preliminary experimental results.

The format for the Workshop included a Panel of invited Subject Matter Experts (collectively referred to as the Expert Panel) well versed in the candidate technologies with a broad experience base in past DoD/DTRA advanced technology programs. This Panel was charged with providing individual critiques regarding the status and potential of four primary high energy technology research areas. The Expert Panel consisted of the Honorable Harold Smith, former DoD/ATSD(NCB) and currently a Distinguished Visiting Scholar and Professor at UC, Berkeley; Dr. Jack Davis, ST Executive, Plasma Physics Division, NRL; Dr. Gerald Yonas, Director, Advanced Concepts Office, Sandia National Laboratory; and Dr. Fred Wikner, former OSD Director of Net Assessment and presently consultant to Applied Research Associates Inc.

To avoid a myriad of disparate perspectives on each of the topic areas, a key expert was assigned to coordinate the presentations in each topic area and to serve as the Chairman of the topic area Panel. The four topic areas and the respective Panel Chairs were:

**Low Energy Nuclear Reactions (LENR), Dr. David Nagel, GWU**

**Anti-Matter Annihilation,** <sup>(b)(6)</sup>

**Nuclear Isomers, Dr. Jim Silk, IDA**

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**Advanced Nuclear Fission and Fusion Concepts, Dr. Don Linger, DTRA**

An additional topic that was discussed but which did not have a Panel was, **Exotic/Extreme Physics.**

Each of the panels presented impressive results showing good progress in experimental design and execution and in first-principal demonstration of energy extraction, containment and control. Unfortunately, none of the energy sources studied are yet sufficiently advanced to be considered for development in the next five to seven years.

The Expert Panel noted the embryonic stage of development of most of the high energy technologies, and commented that DTRA, as a combat support organization, should stay abreast of the work but not necessarily serve as the primary sponsor for these technology areas.

The recommended course at this stage of development is for DTRA to provide some sponsorship, but more importantly, provide leadership in the form of working toward an interagency working agreement to assure its interests are protected and to speed the needed research by preventing overlap or duplication and identifying, with the other agencies, the most fruitful directions for new research.

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## 2.0 Introduction

The High Energy S&T Workshop was a follow-on to the Novel Energetics Workshop but with the focus on energetic materials and phenomena whose energy is derived from the nucleus or subatomic processes. The Workshop objectives were to explore the following five potential areas of high-energy research:

- **Nuclear isomers**
- **Low energy nuclear reactions (LENR)**
- **Anti-matter annihilation**
- **Advanced nuclear fission and fusion concepts**
- **Exotic/extreme physics**

Only the first three topics are discussed in detail this report, because they were the primary focus of the Workshop and could be treated at the unclassified level.

The Workshop was structured to include a Panel of Experts, well versed in the topical areas and familiar with DTRA's missions and research portfolio. The Panel of Experts consisted of:

**The Honorable Harold Smith**, former DoD/ATSD(NCB) and currently a Distinguished Visiting Scholar and Professor at UC, Berkeley

**Dr. Jack Davis**, ST Executive, Plasma Physics Division, NRL

**Dr. Gerald Yonas**, Director, Advanced Concepts Office, Sandia National Laboratory

**Dr. Fred Wikner**, former OSD Director of Net Assessment and presently consultant to Applied Research Associates Inc.

The panel of Experts was instructed to screen and critique candidate high-energy S&T topics and provide recommendations regarding their maturity and relevance for DTRA.

The three topics of Nuclear Isomers, LENR, and Anti-Matter Annihilation were presented as Panel Discussions, starting with an overview by the Panel Chairman; followed by a detailed presentation by each panelist, and finally a discussion period with the Panel of Experts and the Workshop participants.

The following questions were posed for the discussion period:

- Should the high energy S&T topics be included as part of a balanced investment portfolio in "Disruptive Energetics?"
  - Do we understand the underlying physics sufficiently well to proceed with confidence?
  - Do the potential pay-offs outweigh the risks?

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- What should be the focus of the investment?
  - Well-defined, refereed, repeatable experiments?
  - Proof-of-concept tests?
  - Theoretical investigations?
  - Other?
- What are the potential applications?
  - Could these topics underwrite game-changing improvements in warfighting?
- What are the potential risks?
  - How many orders of magnitude of the specific energy density is likely to be lost to system-level packaging?
  - What criticisms should we anticipate from scientists, from the DoD bureaucracy, from Congress, ...?
  - Will these topics bump up against nuclear arms control agreements?

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**FOR OFFICIAL USE ONLY****3.0 Workshop Overview**

The High Energy S&T workshop was held in the DTRA Headquarters Auditorium at Ft. Belvoir, VA. The first day was dedicated to unclassified work while the second day was maintained at the Secret CNWDI level to facilitate in-depth discussions on several of the topics.

**3.1 First-Day Agenda**

The agenda for the first day is shown in Figure 1. Each of the three Panel Chairs provided a summation of their topical area followed by detailed briefings by each of the Panel members. Dr. Bob Park was invited to speak at lunchtime, where he provided a perspective for evaluating new and evolving scientific and technical concepts against risky assumptions and faulty premises.

<b>Agenda – 12 Dec 2006 (Unclassified Session)</b>		
0830	Admin & Introductory Remarks	ASCO Staff, SAIC Staff
0900	OSD Perspective	Spiro Lekoudis, DDR&E
0930	NNSA Perspective	Dave Crandall, NNSA
1000	Break	
1015	<b>Panel 1 – Nuclear Isomers</b>	<b>Jim Silk, IDA (Panel Chair)</b>
	James Carroll, Youngstown State	
	(b)(6)	
	Ehsan Khan, SIER Program Rep	
1215	Lunch	
	<b><i>Luncheon Talk: "A Skeptic's Viewpoint" Bob Park, UMD</i></b>	
1300	<b>Panel 2 – LENR</b>	<b>David Nagel, GWU (Panel Chair)</b>
	Mitchell Swartz, JET Energy Inc.	
	Michael Melich, NPGS	
	Lewis Larsen, Lattice Energy LLC	NET: Allan Widom spoke as well
1500	Break	
1515	<b>Panel 3 – Anti-matter</b>	<b>Ken Edwards, AFRL/MN (Panel Chair)</b>
	Allen Mills, University of California, Riverside	
	Gerry Smith, Positronics Research LLC	
	Paul Csonka, University of Oregon	
1715	Adjourn	

Figure 1. The Energy Workshop Agenda – Day 1

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**Nuclear isomers/isotopes are intriguing energy-storage media, but the question remains: can they be *energy-release* media?**

- Basic research is required before applications can be envisioned
- Efforts should be multi-faceted and multi-institutional
- Focus should expand beyond "Unobtainium" (i.e.  $^{178m2}\text{Hf}$ )
  - including pure spin-isomers (not K-hindered)
  - including electron-capture and internal conversion isotopes
- Experimental evidence should be:
  - tempered with theoretical expectations
  - "open" vetting by experts, including both peers and un-invested community ("open" is TBD by concerned agency)
- After confirmation, system study is still required to deem ready for real life (is efficiency good enough?)
- All of this is required before beginning Manhattan-style effort to produce material

**5.2 Low Energy Nuclear Reaction (LENR) Panel**

**Dr. David Nagel, George Washington University**, chaired the Low Energy Nuclear Reaction (LENR) Panel. He is a Research Professor in the School of Engineering and Applied Science of George Washington University. Dr. Nagel is a recognized authority on low energy nuclear reactions in condensed matter. He commented on the present state of LENR research, noting some of the more important problems impacting LENR research today:

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**FOR OFFICIAL USE ONLY****PROBLEMS**

- **Potential Importance for Energy, Materials and Weapons**
- **Polarization of Scientists**
- **Diverse Mistakes**
- **Technical Complexity**
- **Flows of Money and Information Disrupted Early & Remain Poor**

On the other hand, Dr. Nagel pointed to many recent positive developments that indicate substantial progress in understanding and demonstrating LENR. He also mentioned the need for a theoretical basis to underpin experimental work.

**PROGRESS**

- **Continuous Activity & International Conferences**
- **Better Instrumentation, Calibration and Controls**
- **Some Systematics Found & Verified for Heat Generation Experiments**
- **Nuclear Ash Measured & Correlated with Heat Production**
- **More Attention to Materials**
- **New Experiments Performed**
- **Some Inter-lab Reproducibility**

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**Dr. Mitchell Swartz, JET Energy, INC** presented a brief summary of the results of excess heat experiments in electric-field loaded deuterated metals:

**EXCESS HEAT IN  
ELECTRIC-FIELD LOADED DEUTERATED  
METALS**

**Research and Development**

**BRIEF SUMMARY OF RESULTS:**

**SIGNIFICANT EXCESS HEAT OBSERVED IN PALLADIUM HEAVY  
WATER (PdD) SYSTEM, PALLADIUM HEAVY WATER (PdD)  
CODEPOSITIONAL SYSTEM, SOME NICKEL LIGHT and  
HEAVY/LIGHT WATER SYSTEMS**

**EXCESS HEAT NOT OBSERVED IN IRON, ALUMINUM, OR  
DAMAGED PALLADIUM NICKEL SYSTEMS**



**JET Energy, Inc.**



**DTRA ASCO Workshop  
on High Energy Science and Technology Dec.  
12, 2006**

He explained his methods for controlling measurement error and system noise by using dual calorimeter measurements that allowed precise differential measurement and integration of power. He was thus able to compare measurements of several different instruments to allow judgment of consistency in his reported results.

The diffusion and electrophoresis equations show the advantages of low conductivity electrolytes and relatively high voltages for loading D into the electrodes with co-deposition of electrode material. **Dr. Swartz** obtained energy and power gains over the D charging (loading) input power and discussed the importance of determining optimized operating points. Impressively, he showed a video demonstrating enough power to spin the propeller of a model airplane.

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**FOR OFFICIAL USE ONLY****7.0 Feedback from Panel of Experts**

The Honorable Dr. H Smith, Dr. Jack Davis, Dr. Fred Wikner, and Dr. Gerald Yonas served as subject matter experts and provided their overall review of the Workshop. Their findings and recommendations are summarized in the table below:

	<b>Advisory Board Findings</b>	<b>Advisory Board Recommendations</b>
<b>Isomers</b>	<ul style="list-style-type: none"> <li>Nuclear structure is complex and poorly understood</li> <li>Experiments are ad hoc- not systematic: some interesting data but no triggering observed</li> </ul>	<ul style="list-style-type: none"> <li>Conduct large scale computer simulations like ASCI (not DTRA, NSF or DOE)</li> <li>Experiments-long term; guided by theory, funded by NSF and DOE</li> </ul>
<b>LENR</b>	<ul style="list-style-type: none"> <li>There is good evidence of excess heat and transmutation</li> <li>New theory by Widom shows promise; collective surface effects, not fusion</li> <li>Low energy implantation of ions</li> </ul>	<ul style="list-style-type: none"> <li>Careful experiments confirm and expand data base</li> <li>Expand theory field with more participants</li> <li>Other experiments included</li> </ul>
<b>Anti-Matter</b>	<ul style="list-style-type: none"> <li>Systematic approach required: how to manage it</li> <li>Experiments will require substantial increments</li> </ul>	<ul style="list-style-type: none"> <li>Not suitable for DTRA, a combat support agency.</li> </ul>
<b>Nuclear Weapons</b>	<ul style="list-style-type: none"> <li>DoD needs low residual radiation weapon; DOE knows how to RDT and produce them</li> </ul>	<ul style="list-style-type: none"> <li>US DOE should proceed; DOD should provide requirements</li> </ul>
<b>General Observations</b>	<ul style="list-style-type: none"> <li>Agency staffs and services are increasingly risk adverse</li> </ul>	<ul style="list-style-type: none"> <li>Defense research establishment must think creatively about new concepts</li> </ul>

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### 9.0 Recommendations

**Novel Energy Strategy:** The Expert Panel noted that there many potentially interested agencies and that DTRA, as a new 6.1 agency, will need to find its niche. It is recommended that DTRA form and/or participate in an Interagency Novel Energy Working Group. Partnering agencies would include DTRA, DOE/NSSA, the National Laboratories, DHS, DARPA, NSF, and the Service Labs. The charter would be to coordinate budgets for maximum return and chart a course that would accelerate development of advanced energy concepts.

**Isomer Energy Storage:** The extraordinary claims regarding the de-excitation of  $\text{Hf}^{178\text{m}2}$  appear to have been thoroughly discredited. Nonetheless, it may be warranted to fund some basic research to continue screening candidate isomers, to develop an improved understanding of the physics of isomer de-excitation, and to explore de-excitation methods other than x-ray stimulation. There are no likely near-term military applications of nuclear isomers.

**LENR:** LENR still suffers from negative publicity associated with Cold Fusion and is viewed as being conducted outside the domain of legitimate, mainstream science. Nonetheless, the persistent and increasingly repeatable demonstrations of excess heat and transmutation suggest that there is something here worth pursuing. DTRA should not do so alone, but rather foster consortia that would help bring discipline and rigorous experimental protocol to this field. Additionally, efforts to better understand the physics of LENR as well as the development of first-principle predictive models are encouraged.

**Anti-Matter:** The challenge of stable storage of positrons in the form of positronium may be surmountable but progress to date has been modest. Near-term applications of this technology appear to be ill-advised. Additionally, the large parasitic mass associated with the storage of positronium and the small amount that can be stored, even under the most optimistic projections, effectively limits the system-level energy density. Nonetheless, some basic 6.1 research should be invested in keeping the effort alive. Perhaps an alliance between DTRA and NSF would be useful in this regard.

**4<sup>th</sup> Generation Nuclear Weapons:** DTRA, in cooperation with NNSA and with the approval of OSD, should consider supporting a few pilot studies to explore the potential applications of 4<sup>th</sup> generation nuclear weapons to meet projected future national security needs, explore the potential impact of such weapons if they were to be used against U.S. forces or infrastructure, and examine their overall policy implications.

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## 8.0 Workshop Summary

The High Energy Workshop endeavored to assemble the recognized experts in each of the energy categories to survey the state-of-art. The presentations did elucidate the state of science but of course were limited in depth based on time available. At the end of the Workshop, an early summary or "Hot Wash" debrief was presented to the senior DTRA leadership on the salient points made in the two days presentation. It is included in Appendix B.

**Nuclear Isomers** research has not yet provided evidence of reliable and effective triggering mechanisms. Production seems feasible, though engineering development is needed to scale up to practical amounts of material. The complexity of isomeric excited states and their induced depletion paths leads us not to expect too much from better theory or intense calculational efforts.

Yet, one cannot help but be intrigued by potentially gaining access to such highly energetic states for military applications. At this stage, modest investments related to the study of isomers and the physics of de-excitation would appear to be prudent. Also, improvements in experimental methods and diagnostic tools may be warranted.

Clearly, isomer production is not now the greatest roadblock to a proof-of-principal demonstration and should not be pursued at this time. A more fundamental issue is demonstration of a robust triggering approach. Here more experimental work is useful if focused on development of techniques for analyzing gamma spectra and measurement of depletion rates. Equally important would be innovative approaches to nuclear structure and transition probabilities. Weapons applications based on isomeric payloads are premature and should not be pursued.

**Low Energy Nuclear Reactions** are showing some remarkable progress with respect to energy (excess heat) production and transmuted element detection, but experiments remain only thinly reproducible. LENR also suffers from a basic lack of understanding of the governing physics.

There is also a compelling need for a theory that can explain production rates and lead to specific electrode treatments and electrolyte compositions and predictions of reaction power, energy and products. The Widom theoretical construct appears promising, but lacks robust experimental verification and rigorous peer review.

**NET: Widom-Larsen theory published in peer-reviewed Eur. Phys. J. C nine months before, March 2006**

The polarizing history of LENR is a detriment to expanding research efforts and it seems unlikely that deployable/useable devices could be expected within a five to ten year horizon. Some low-level funding by 6.1 agencies seems appropriate, both to exploit the possibility of a breakthrough and to monitor other (international) research in this field. Nonetheless, DTRA should not go it alone; rather, it should provide the leadership to build interagency research consortia with a focus on fostering improved research facilities and rigorous experimental protocols.

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**Anti-Matter** research has provided encouraging results to suggest that positrons, in the form of positronium, may be efficiently stored with reasonable lifetimes. Clearly, stable sources of Ps capable of generating intense gamma pulses could have numerous interesting military applications. Methods to package Ps with longer life times and useful densities will require considerable experimentation and development, as will achieving efficient and affordable positron production methods.

A modest 6.1 program would keep DTRA in play on any future decisions regarding the feasibility of weaponizing anti-matter.

**4<sup>th</sup> Generation Nuclear Weapons Concepts** appear to be attractive for a number of military objectives, especially in situations needing low yield and low residual radioactivity

(b)(3):10 USC 128

The military effectiveness of such weapons will need to be characterized in detail in concert with suitable concepts of operation. The policy implications, in terms of how such weapons may be used and whether they meet current legal strictures and arms control restrictions, must also be examined. In view of this concern, expressed by several members of the Expert Panel, a cursory review of the current legal definition of nuclear weapons was commissioned by DTRA and is provided in Appendix D.

Given the congressional restrictions on pursuing new nuclear weapons concepts, it is not clear what DTRA's role should be other than to stay abreast of new developments in this area, as a hedge against technology surprise and a new wave of proliferation. Also, a review of the potential implications to the U.S. national security posture, should such weapons be developed by others, would appear to be well advised.

A **Workshop Summary Report** briefing was compiled following the workshop and was presented to DTRA sponsors of the workshop. It is provided in Appendix C.

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**Appendix B  
Hot-Wash Briefing to DTRA  
December 13, 2007**

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***High Energy Workshop***

***Expert Panel Findings and Recommendations***

***12-13 December 2006  
Defense Threat Reduction Center  
Fort Belvoir, VA***



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**Findings & Recommendations  
Isomers**

- Findings
  - Nuclear structure is complex and poorly understood
  - Experiments ad-hoc – not systematic
    - Some good data
    - Hafnium triggering inconclusive and not energetically break-even
- Recommendations
  - Theoretical structure and reaction studies are needed
  - Experiments –Long-term, guided by theory, red-teamed

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**Findings & Recommendations  
LENR**

- Findings
  - Good evidence of excess heat and transmutation
  - Widom-Larsen theory shows promise: collective surface effects ... not fusion
  - Low energy implantation of ions
- Recommendations
  - Careful experiments to confirm data base
  - Expand theory field – need more players
  - Other experiments warranted

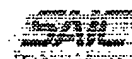
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**Appendix C**  
**Summary Report Of High Energy Workshop**

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**High Energy Workshop**  
**Sponsored by DTRA/ASCO**

*12 – 13 December 2006*  
*Defense Threat Reduction Center*  
*Ft. Belvoir, VA*

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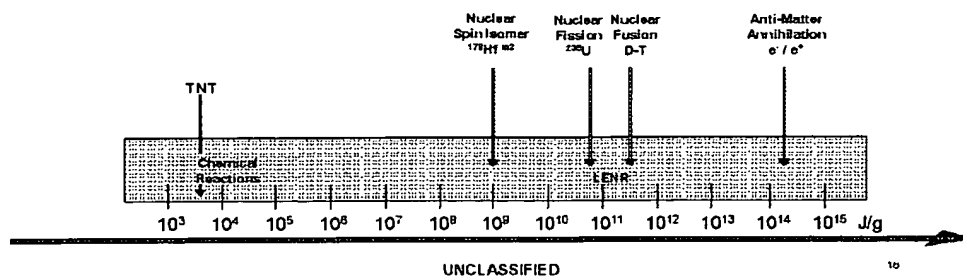
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## Workshop Objectives

**SAC**  
Special Activities Center

- Survey and assess the S&T of highly energetic materials, whose energy is released via nuclear and subatomic processes ( $>10^6$  eV/unit-event)
  - Nuclear Isomers
  - Low energy nuclear reactions (LENR)
  - Anti-matter Annihilation
  - Advanced nuclear fission and fusion
  - Exotic/Extreme Physics



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## Key Considerations

**SAC**  
Special Activities Center

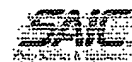
- Should these topics be included as part of a balanced investment portfolio in "Disruptive Energetics?"
  - Do we understand the underlying physics sufficiently well to proceed with confidence?
  - Do the potential pay-offs outweigh the risks?
- What should be the focus of the investment?
  - Well-defined, refereed, repeatable experiments?
  - Proof-of-concept tests?
  - Theoretical investigations?
  - Other?
- What are the potential applications?
  - Could these topics underwrite game-changing improvements in warfighting?
- What are the potential risks?
  - How many orders of magnitude of the specific energy density is likely to be lost to system-level packaging?
  - What criticisms should we anticipate from scientists, from the DoD bureaucracy, from Congress, ...?
  - Will these topics bump up against nuclear arms control agreements?

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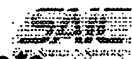
**Widom-Larsen Theory Explains ...**

- Excess heat in electrochemical cells
- Nuclear transmutation abundances in electrochemical cells (total rates shown to be in agreement with experiment)
- Transmutations observed in exploding wire experiments as early as 1922

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**Advanced Nuclear Weapons Concepts**

Sandia Z-Machine



Z-pinch Wire Array

- Tailored Output Devices
  - Nuclear-driven directed energy
    - X-ray laser
    - Kinetic projectile array
  - Enhanced radiation weapon
  - Enhanced, localized EMP
- Pure Fusion Device
  - DT pellet implosion
    - Enhanced energetic material direct drive
    - Plasma Z-pinch drive
  - Essentially fall-out free
    - Some short-lived, neutron-activated radioactive isotopes

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